

BOOK REVIEWS

IMAGING WITH IONIZING RADIATIONS (VOLUME I). K. Kouris, N. M. Spyrou, and D. F. Jackson. Glasgow and London, Surrey University Press, 1982, 204 pp, £29.75

This monograph is the first in a series entitled *Progress in Medical and Environmental Physics. Imaging With Ionizing Radiations* is intended to describe new developments in the applications of physical techniques in medicine. The book is proposed for graduate scientists and engineers or as a critical review for experienced workers in the fields. The first three chapters, which are rather general, are relevant to subsequent volumes in addition to the purpose of this first volume. The remaining four chapters deal with x-ray, charged particle, radionuclide, and positron imaging, respectively. Finally, there is a four-part appendix.

The first chapter introduces the concepts and definitions in imaging and traces the historical development of emission and transmission imaging but includes some discussion of other imaging modalities.

Chapter Two introduces information theory and linear systems. In the attempt to describe these topics in general terms without being specific to a particular imaging technique, the results become vague and difficult to relate to application. Parameters for defining image quality are described and sampling and ROC analysis covered.

Chapter Three discusses the theory of reconstruction from projections. From a generalized development of a continuous projection approach, the discrete case is developed, and classification of reconstruction methods is divided between transform and series expansion methods. For transform methods, the convolution back-projection technique is described for both parallel and fan beam geometries. Implementation in Fourier space is also presented as is a discussion of convolving functions. Series expansion methods concentrate on the algebraic reconstruction techniques. This chapter concludes with brief discussions of optimization criteria, 3-D imaging reconstruction, computer simulation programs, and noise.

In Chapter Four more specific discussions are given, beginning with x-ray radiography and transmission tomography. From the chapter title one would anticipate some discussion of conventional radiography, but the chapter is devoted almost exclusively to x-ray CT. There is an extensive discourse on the limitations of quantitative computed tomography and the different approaches that have been tried to solve this problem. The sequence of topics in this chapter is confusing.

Chapter Five, on charged particle radiography and tomography, adequately describes the physical principles underlying energy loss mechanisms of charged particles and charged particle scattering. A discussion of the different methods of radiography and tomography by charged particles is clear and concise and the advantage of charged particles over x-rays is emphasized and clearly explained. Considering the stage of development and extent of application of this technique, to devote a whole chapter, however, seems to be an overemphasis when compared with the other imaging methods using ionizing radiation.

Chapter Six, "Radionuclide Imaging and Gamma Ray Emission Tomography," includes a very good description of gamma ray imaging from both the general sense and the specifics of detection efficiency and energy resolution. The section on scattering is

particularly good, with emphasis on the magnitude of this problem in gamma ray imaging. The discussion of nonlinearity and nonuniformities of scintillation cameras is up-to-date. The second half of the chapter on gamma ray tomography, however, suffers from some confusion because of the order of presentation. A general formulation for emission tomography given in the middle of this section would have been more appropriately presented at the beginning of the tomographic discussion. Most gamma ray tomography today is performed with rotating scintillation cameras, but little discussion is provided on this topic. Most of the emission tomography systems described are limited angle tomography, such as multiple pinhole or coded aperture.

The last chapter on positron emission tomography is covered very well, presenting an overview of positron interactions and annihilation and continuing in a logical fashion through other topics unique and relevant to this imaging technique. The attenuation problem in emission tomography and its simpler solution with positron tomography is explained, and discussions of spatial sampling, instruments, and time-of-flight techniques are included. At the end of the chapter several clinical applications are provided.

The appendix is an unusual mixture of four subjects: (a) mathematical background including a discussion of the Dirac delta function and Fourier transforms; (b) probability theory including axioms, random variables, and stochastic processes; (c) compartmental analysis describing cerebral blood flow and oxygen metabolism, distribution of red cells, and cerebral glucose metabolism; and (d) detectors for imaging devices and the parameters for detector performance evaluation.

Although this monograph is relatively small, it cannot be assimilated in one reading. The descriptions for the most part are mathematical, but sometimes the logic of the sequence of subject presentation is unclear. I feel, however, that it is a useful reference text for the scientist-engineer with previous experience in medical imaging.

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ATLAS OF RADIONUCLIDE HEPATOBILIARY IMAGING. C. C. Kuni, W. C. Klingensmith, III. Boston, G. K. Hall Medical Publishers, 1983, 222 pp, \$39.95

The maturing of a field is often marked by the appearance of a "field guide" or "atlas." We are particularly reminded of the series of volumes entitled *Atlas of Nuclear Medicine* produced by DeLand, Wagner, and Dibos during the period 1969-1978. Hepatobiliary imaging has progressed to the point where an atlas is indicated for the practitioner of nuclear medicine; based upon their experience, Kuni and Klingensmith have produced such a work, presenting an account of Tc-99m iminodiacetic acid hepatobiliary agents and their clinical utilization. Chapter 1 gives a brief history of I-131 rose bengal and a comparison with Tc-99m labeled compounds. The chemical structure of iminodiacetic acid is not given, however, and the effects of additions to the ring on lipid solubility and partitioning are not clearly developed. Hepatic

extraction, hepatobiliary transit, and renal clearance are briefly discussed. The conclusion that "... Tc-99m trimethylbromo-IDA is currently the hepatobiliary radiopharmaceutical of choice ..." may be correct, but awaits a wider evaluation. Chapter 2 discusses the technique of performing a hepatobiliary study and also mentions the effect of fasting on gallbladder entry of the label. Curiously, however, there is no detailed discussion of the role played by cholecystokinin. The remaining chapters deal with the normal and abnormal appearance of hepatobiliary studies. Several tables aid in the interpretation of information. Many of the case presentations are followed by references to the recent literature. This is an interesting collection of cases by two authors who have a wide clinical base in performing hepatobiliary imaging.

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NONINVASIVE TECHNIQUES FOR ASSESSMENT OF ATHEROSCLEROSIS IN PERIPHERAL, CAROTID, AND CORONARY ARTERIES. T. F. Budinger, A. S. Berson, I. Ringqvist, M. B. Mock, J. T. Watson, R. S. Powell, Eds. New York, Raven Press, 1982, 271 pp, \$49.00.

This book, which is based on an NIH workshop, reviews the current status of the various noninvasive modalities available for the detection of atherosclerotic vascular disease. Because of the workshop format, the material focuses on atherosclerotic disease, rather than diagnostic issues of a more general nature. Nevertheless, sufficient good general information about the various imaging modalities is provided. Ultrasound imaging, Doppler techniques, nuclear magnetic resonance imaging, and digital subtraction angiography are covered in separate chapters. Other topics, such as dynamic spatial reconstruction, are also discussed. The chapter by Dr. Budinger on emission tomography (i.e., single photon tomography and positron tomography) is especially thorough.

The book is organized in three sections containing concise chapters, which are individually referenced. The first section presents the pathology and natural history of atherosclerosis. The second section focuses on the need for noninvasive tests for studying atherosclerotic disease of peripheral, carotid, and coronary arteries. The third and largest section reviews the status of clinical applications of the various modalities to atherosclerotic disease. Also included are "commentary" chapters, in which an expert gives his opinion of the issues discussed in the previous section, and these commentaries help place the discussions of the various diagnostic modalities in proper perspective.

Some diagnostic modalities are reviewed in more depth than others—ultrasound and Doppler techniques are the most thoroughly reviewed topics, but the information on digital subtraction angiography is substantially behind the state-of-1983 knowledge and experience. The book should be of greatest value to the clinician or scientist not currently involved with diagnostic imaging or who is familiar with only one or two of the modalities discussed and wishes to read a survey of the current status of the other noninvasive techniques.

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BONE METASTASIS. L. Weiss, H. A. Gilbert, Eds. Boston, G. K. Hall Medical Publishers, 1981, 512 pp, \$57.50

This fourth volume of a series on metastatic disease is an expansion of a conglomerate of papers presented at a workshop on

the subject of bone metastases. The multiauthored text is divided into six sections dealing with background-to-bone metastases, diagnosis, rehabilitation, drug therapy, surgical procedures, and radiation therapy.

The first part, undoubtedly the most interesting, includes the original description of the vertebral vein system by Oscar Batson. Other excellent contributions to this section include the chapter by Gallino and Liotta on cell shedding and one by Kuettnner and Pauli on resistance of cartilage to tumor invasion. The second part, on diagnosis, includes relevant reviews of radiology and computerized medicine as well as a superficial section on radionuclide scanning. The third part, on rehabilitation, includes only one chapter dealing with the psychosocial and economic aspects of cancer with regard to the patient, the family, and society. Although not specifically related to the general theme, it is an adequate reminder of the complex issues involved. Part 4 covers drug therapy and is possibly the weakest. Beginning with a paper on the pharmacokinetics of adriamycin, which belongs elsewhere, and followed by two simplistic and repetitive presentations on chemotherapy, this section is rescued only by a first-rate review on the management of pain. In the section on surgical procedures there is only one chapter. This excellent summary on the management of malignant pathologic fractures, however, contains some erroneous information on radiation doses and fractionation. The last part covers radiation therapy, but the chapters are quite dissimilar, with some being of high quality and others superfluous. These discussions are on the philosophy, economics, and techniques of palliative irradiation.

This volume exhibits the inherent difficulties of a multiauthored text, but it will still provide an adequate review of the subject of bone metastases for students and practitioners in contact with cancer patients.

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BONE RADIOLOGY CASE STUDIES. T. C. Demos. Thorofare, NJ, Chas. B. Slack/Book Division, 1982, 344 pp, \$39.50.

This well-constructed volume demonstrates the inherent advantages and deficiencies of a "case studies" approach to a medical subject. These advantages include the presentation of interesting and varied material that is easy to read as well as abundant information on many types of osseous pathology. A major appeal is that there is focus on an individual patient. This is an instructive format for individuals at various levels of expertise, from neophytes who want to learn about a specific entity to informed physicians who wish to review the subject. The fundamental deficiency of this or any other collection of "case studies," however, is the absence of a comprehensive and integrated coverage of the subject. To overcome this problem the authors have added an introductory chapter, but the basic nature of a book of this type as well as the magnitude of his subject negate somewhat the adequacy of the objective.

The considerable number of lists of diseases that exhibit specific radiological findings gives the volume a "gamut" aura. You will like this aspect of the book if you believe "gamuts" are a worthwhile approach to medical education. Because many entities can be placed in several different categories with equal relevancy, any classification of the radiological findings of bone disease is very difficult, perhaps impossible. Unfortunately, Dr. Demos has not been able to improve this type of presentation. I should mention that there are minimal errors such as inverted radiographs, misspellings, etc., that could detract from the book's value or appeal. The illustrations, although profuse, vary in quality from acceptable to fairly good, but the narrative portions of the book are more in-